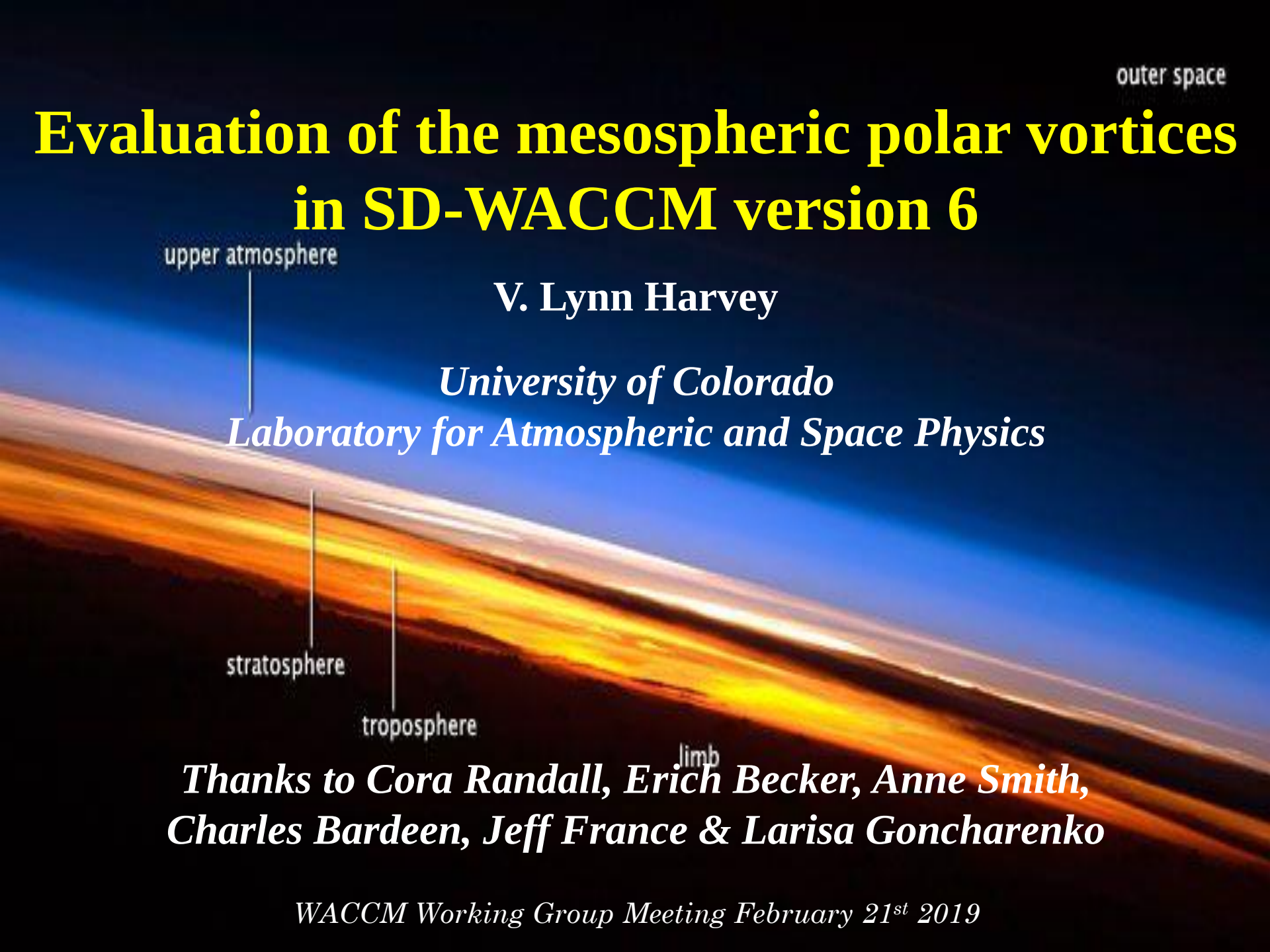

Evaluation of the mesospheric polar vortices in SD-WACCM version 6

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Thanks to Cora Randall, Erich Becker, Anne Smith, Charles Bardeen, Jeff France & Larisa Goncharenko

WACCM Working Group Meeting February 21st 2019

Outline

- **Motivation**
- **Background Temperature and Zonal Wind**
- **The winter Polar Vortex**
  - **Seasonal mean frequency of occurrence**
  - **Evolution during SSW**

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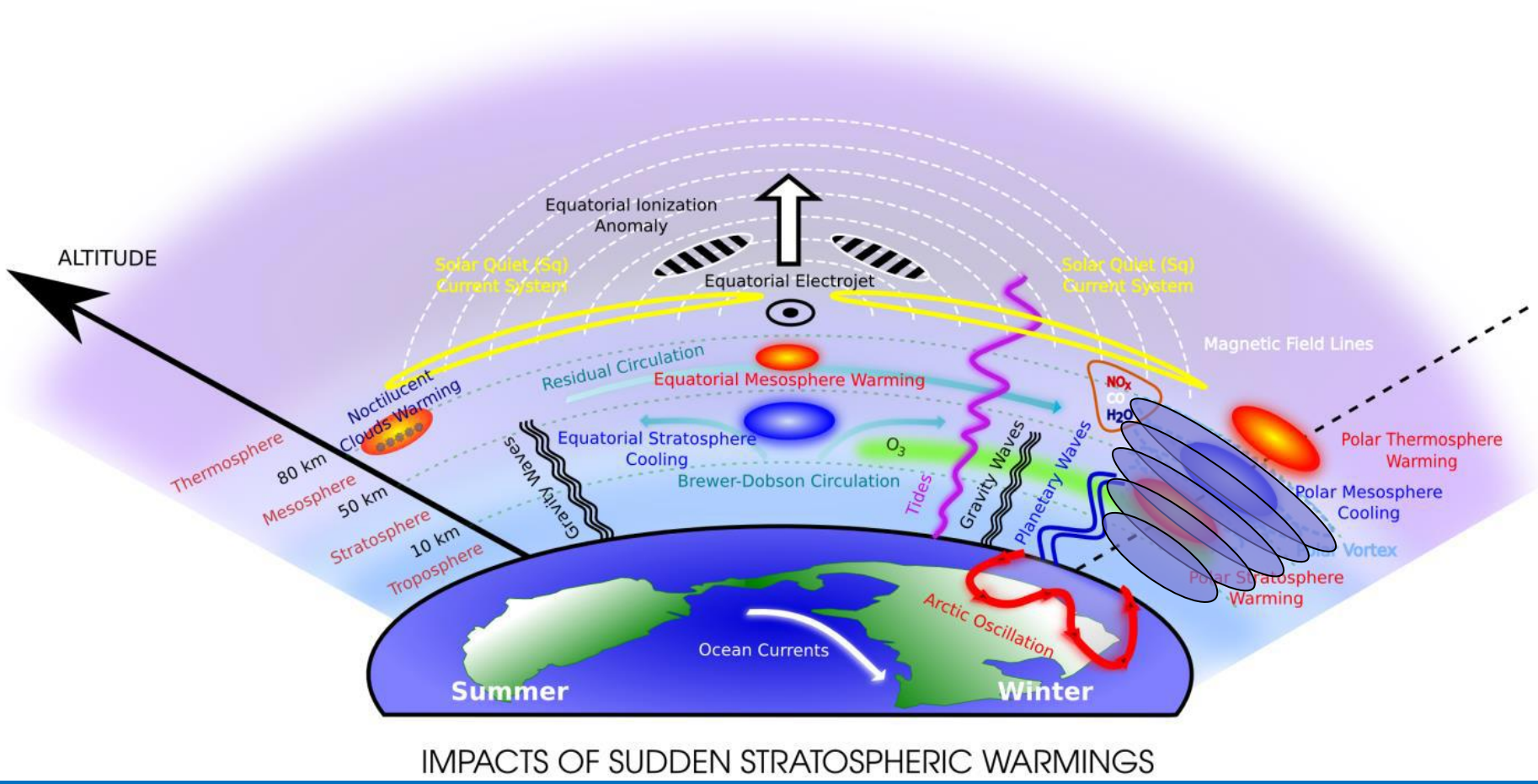
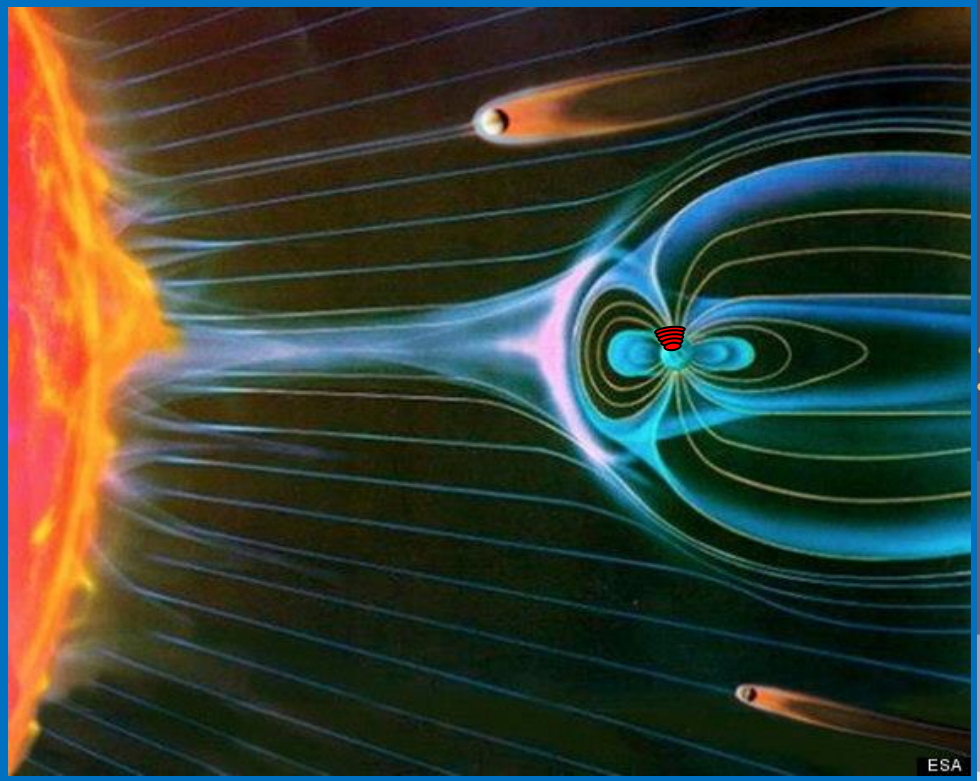
Effects of SSW are observed throughout the whole atmosphere

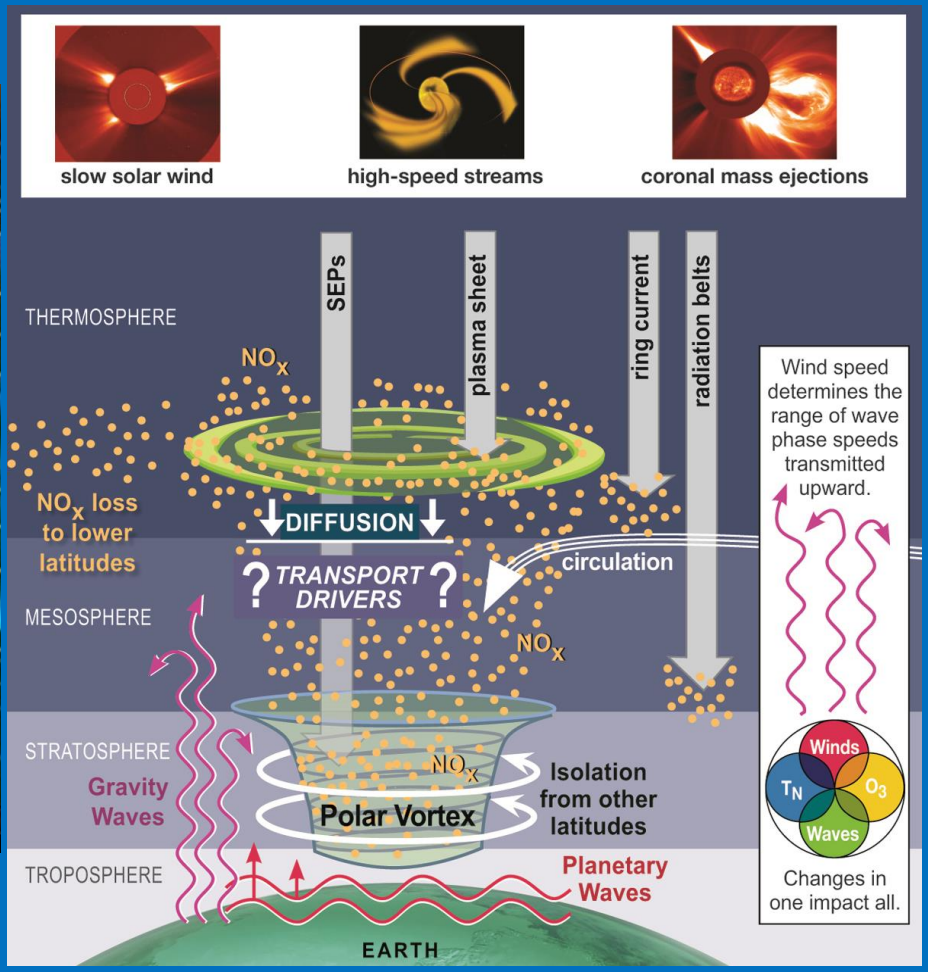


From *Pedatella et al.* (2018) EoS

The vortex links space weather to the lower atmosphere



EPP-> NOx-> O_3 -> Temp -> Waves



Descent of NOx is underestimated by global models

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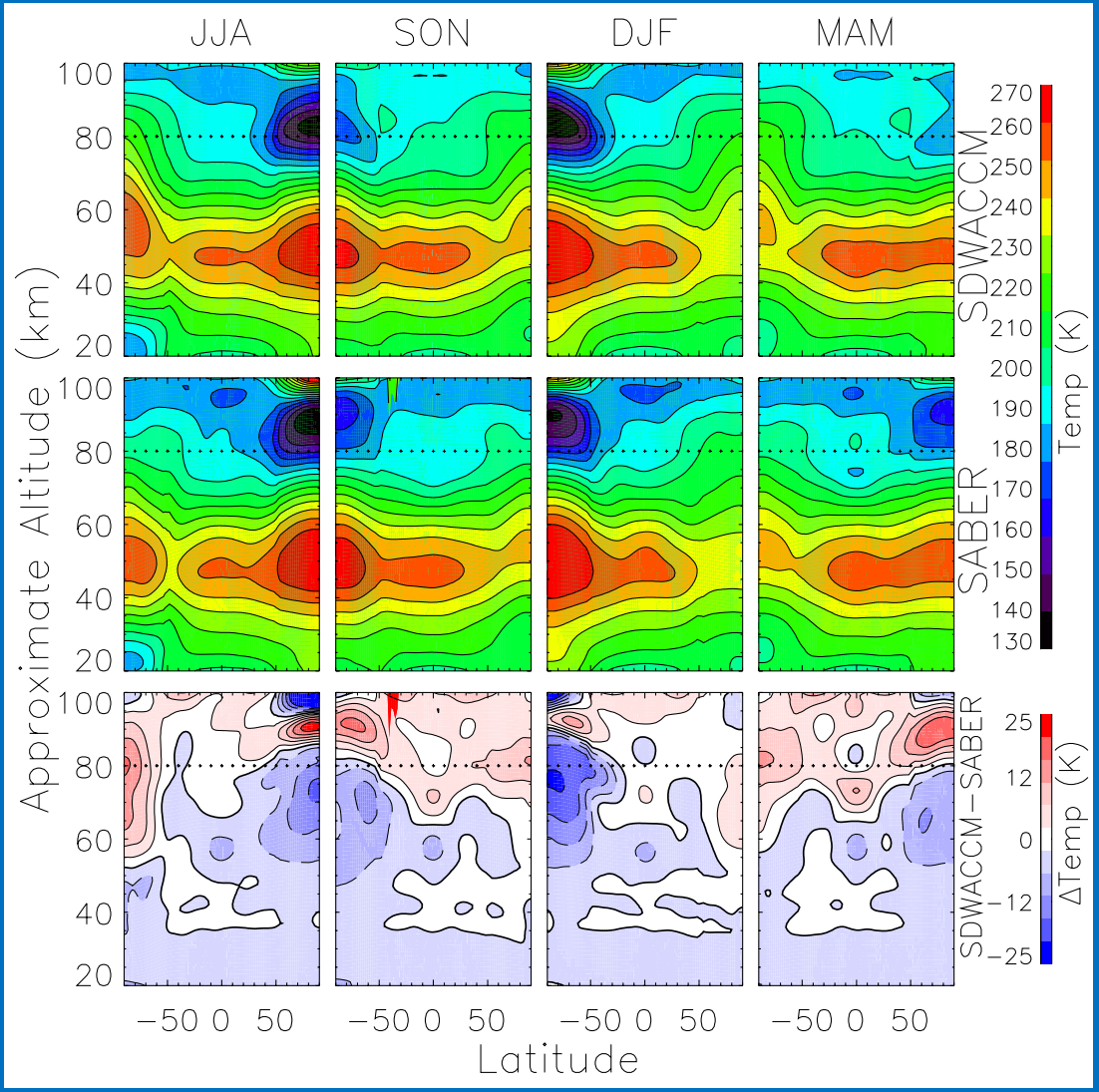
Colder in summer and warmer in winter mesosphere suggests too strong residual circulation

2005-2017

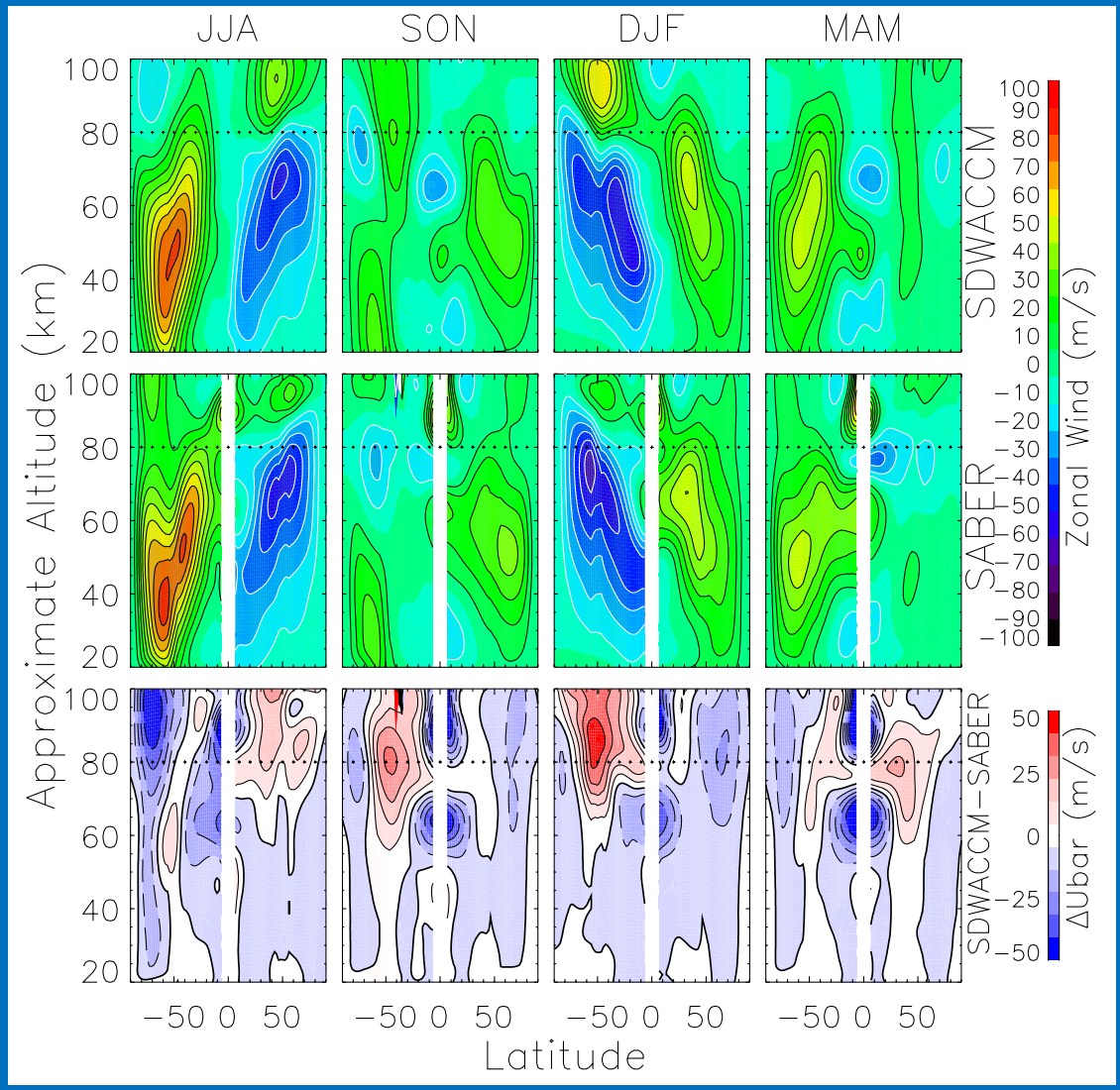


WACCM is sampled at SABER locations

The model is nudged to MERRA-2 below 60 km

Results similar to previous model versions (*Smith*, 2012; *Marsh et al.*, 2013)

Between 80 and 100 km in the polar regions there are easterlies in the model, westerlies in SABER



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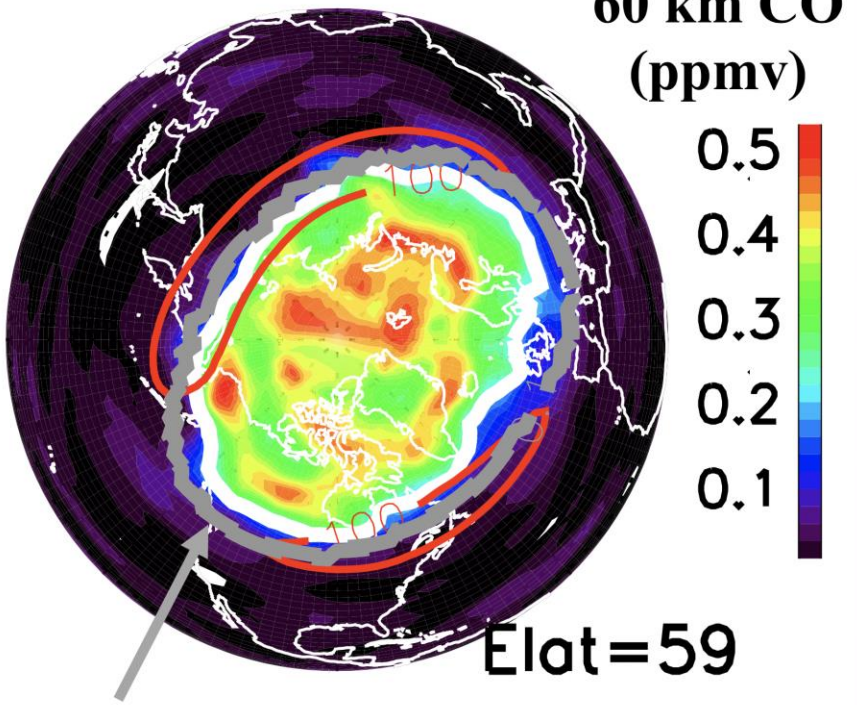
Chemical definition of the mesospheric vortex

- **"CO Gradient Algorithm" for use in the mesosphere**
- See *Harvey et al.* [2015]
- Calculate equivalent latitude based on **MLS** CO distribution
- Candidate edges where local maxima in CO gradients taken as a function of equivalent latitude.
- Vortex edge is the equatorward-most "candidate", provided the strength of the it's gradient exceeds 50% of the maximum gradient at any latitude.



gray contour: ψ vortex edge
white contour: CO gradient vortex edge

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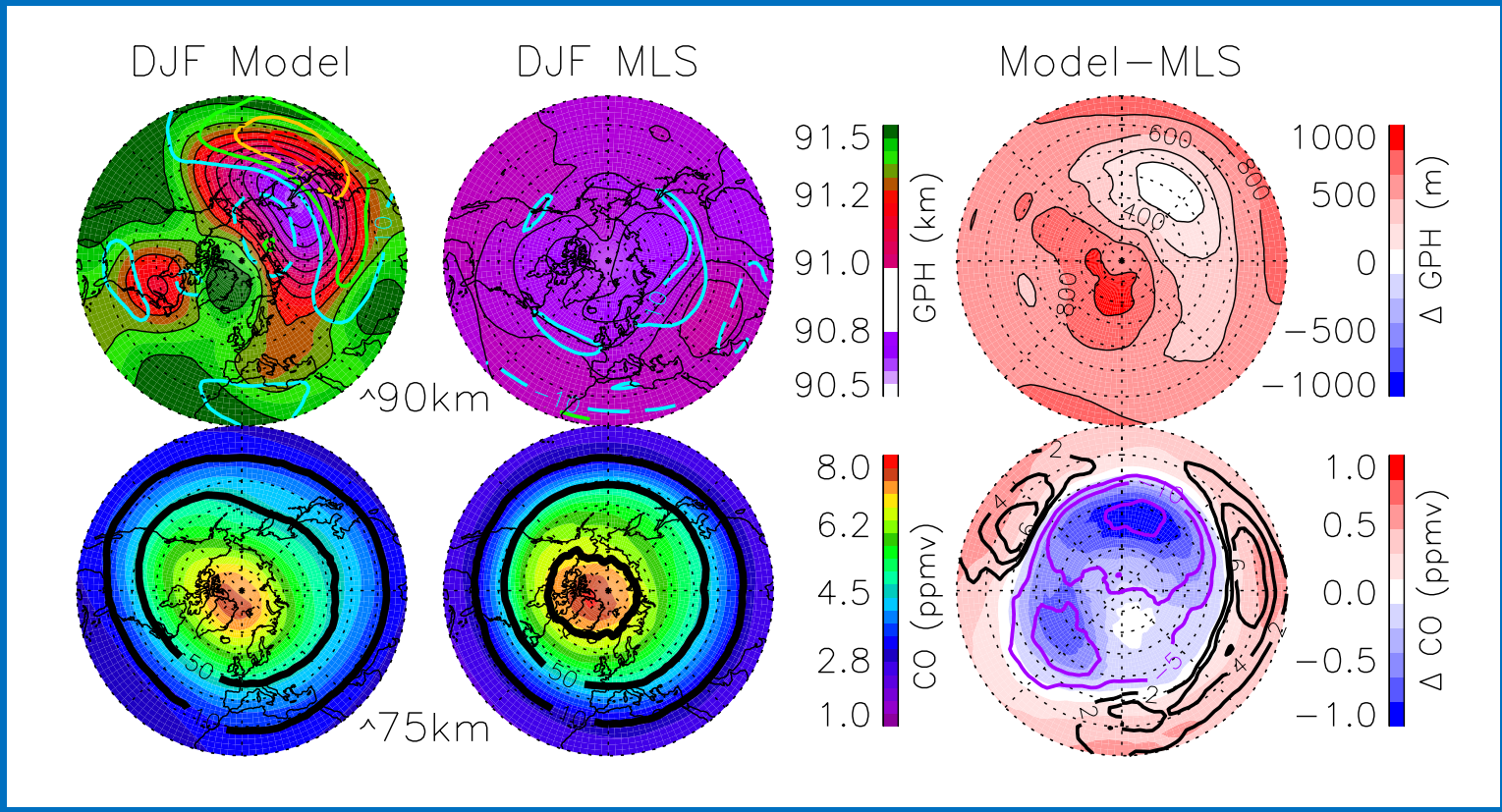
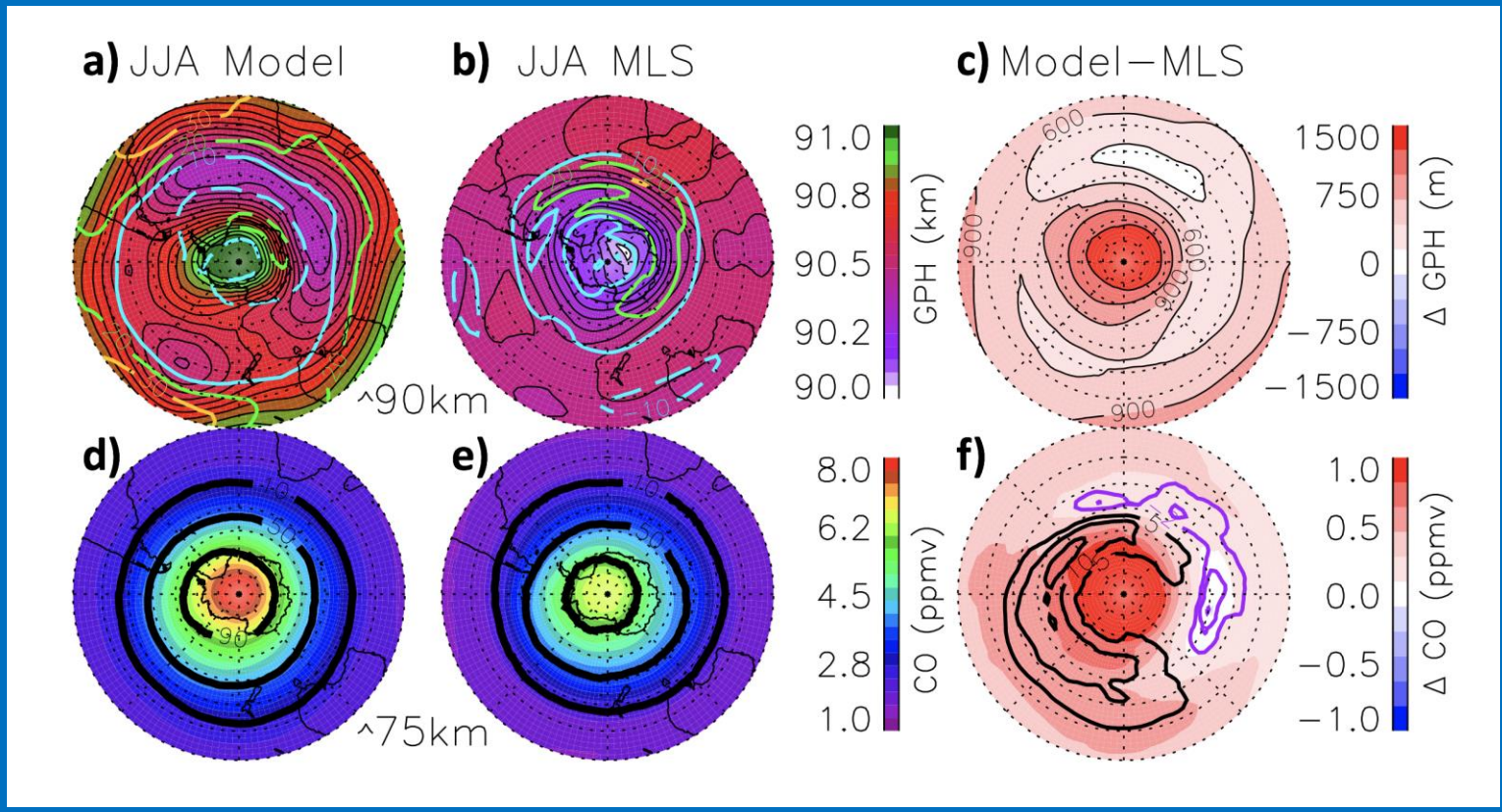
In the Arctic winter at 75 km, the model reproduces the mesospheric vortex reasonably well



At 90 km, the model shows a highly displaced cyclone compared to a weak circumpolar low in MLS.

In the Antarctic winter at 75 km, the model reproduces the mesospheric vortex reasonably well



At 90 km, the model shows an anticyclone compared to a cyclone in MLS.

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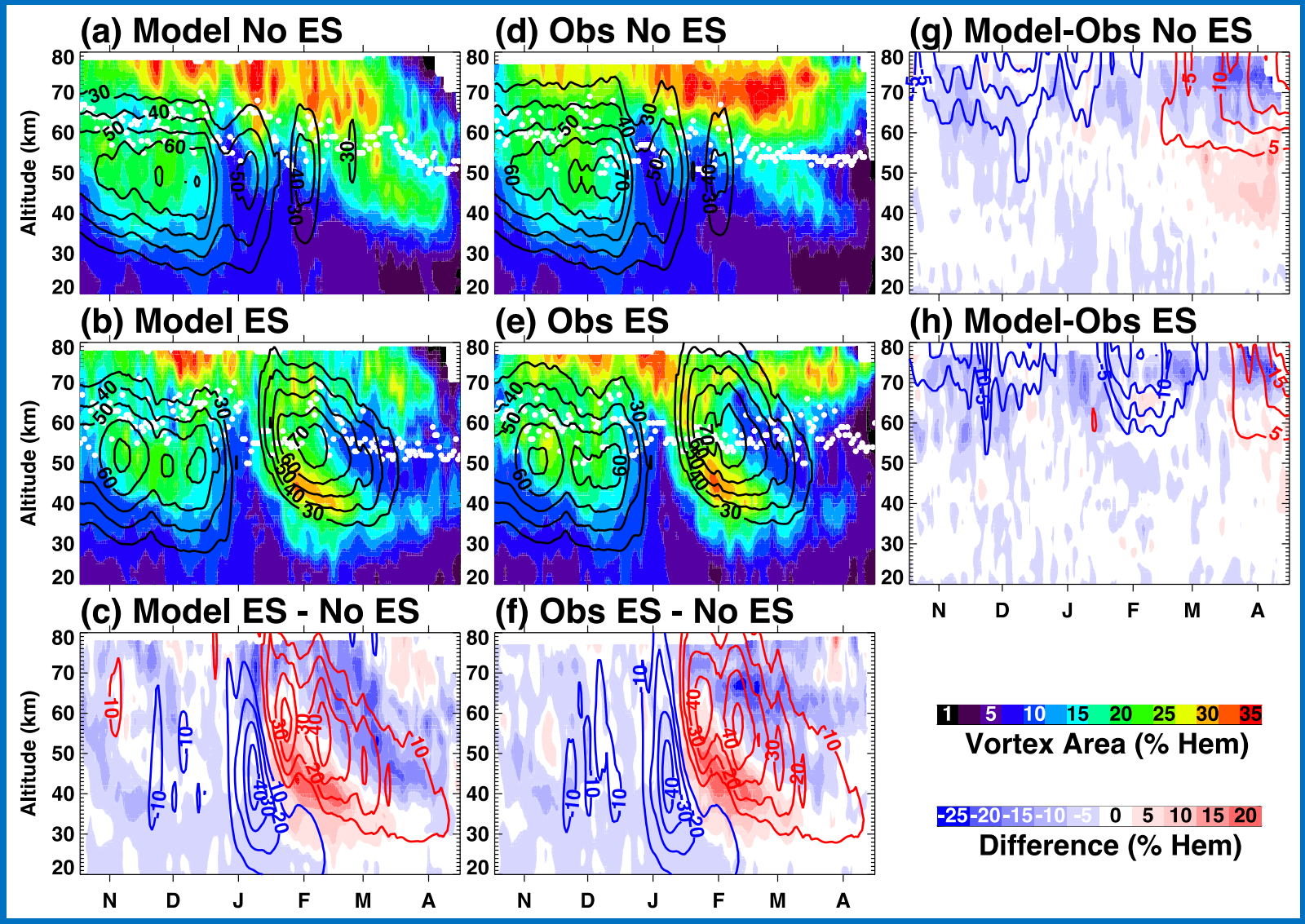
SD-WACCM version 6 reproduces observed contraction of the mesospheric vortex following SSW



Take away points

- **Residual circulation too strong in WACCM**
- **Premature reversal of the winter polar night jet**
- **Vortex is well represented up to 75 km but circulation is fundamentally different at 90 km**
- **Differences attributed to GW and PW**
- **WACCM reproduces mesospheric vortex contraction following prolonged SSW**

Thank You!